PCT/ZA02/00211

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DEPARTMENT OF TRADE
AND INDUSTRY

Hiermee word gesertifiseer dat
This is to certify that

the documents annexed hereto are true copies of:

Application forms P.1 and P. 2 , provisional specification and drawings of South African Patent Application No. 2001/5465 as originally filed in the Republic of South Africa on 3 July 2001 and post-dated to 3 January 2002 in the name of NXCO INTERNATIONAL LIMITED for an invention entitled: " TIMED SHOCKWAVE CONCENTRATOR".

Geteken te PRETORIA in die Republiek van Suid-Afrika, hierdie 15th dag van May 2003
Signed at PRETORIA in the Republic of South Africa, this 15th day of May 2003

Registrateur van Patente
Registrar of Patents

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) or (b)

FORM P2
M R & F Ref: P.19159/Case 9

REPUBLIC OF SOUTH AFRICA

PATENTS ACT, 1978

Post-dated

REGISTRAR OF PATENTS

Official Application No.			Lodging date: Provisional		Acceptance date:	
21	01	20015465	22	~~3 JULY 2001~~ 3.1.2002	47	
International classification			Lodging date: Complete		Granted date:	
51			23			

Full name(s) of applicant(s)/Patentee(s)

71 NXCO INTERNATIONAL LIMITED

Applicant(s) substituted:		Date Registered:
71		

Assignee(s):		Date Registered:
71		

Full name(s) of inventor(s)

72 To be advised

Priority claimed	Country		Number		Date	
Note:	33	NONE	31	NONE	32	NONE
Use International	33		31		32	
Abbreviation for Country	33		31		32	

Title of Invention:

54 TIMED SHOCKWAVE CONCENTRATOR

Address of applicant(s)/patentee(s)

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Patent of Addition No.	Date of any change:	
Fresh Application based on:	Date of any change:	

McCALLUM, RADEMEYER & FREIMOND
Ref: P19159/Case 9

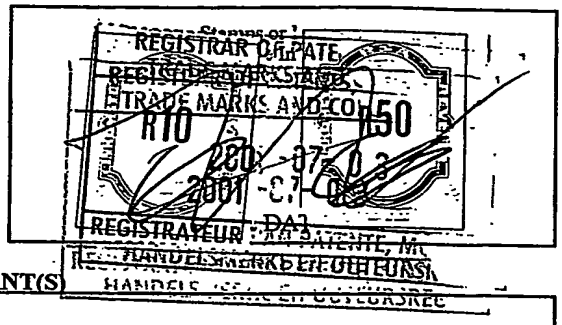
FORM P1

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF RECEIPT

(Section 30(1) - Regulation 22)

The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate



OFFICIAL APPLICATION NO.

21	01	20015465

FULL NAME(S) OF APPLICANT(S)

71	NXCO INTERNATIONAL LIMITED

ADDRESS(ES) OF APPLICANT(S)

Saffrey Square, Suite 205, Bank Lane, Nassau, Bahamas

TITLE OF INVENTION

54	TIMED SHOCKWAVE CONCENTRATOR

Priority is claimed as set out on the accompanying Form P2.
The earliest priority claimed is :

This application is a patent of addition to Patent Application No.	21	01	
This application is a fresh application in terms of section 37 and based on Application No.	21	01	

THIS APPLICATION IS ACCOMPANIED BY:

X	1	A single copy of a provisional specification of 9 pages			
	2	Two copies of a complete specification of ..... pages			
X	3	.1. sheets of Informal Drawings			
	4	..... sheets of Formal Drawings			
	5	Publication particulars and abstract (Form P8 in duplicate)			
	6	A copy of Figure ..... of drawings (if any) for the abstract			
	7	Assignment of Invention			
	8	Certified priority document(s) Number(s)			
	9	Translation of priority document(s)			
	10	An assignment of priority rights			
	11	A copy of the Form P2 and the specification of SA Patent Application No.	21	01	
	12	A declaration and power of attorney on Form P3			
	13	Request for ante-dating on Form P4			
	14	Request for classification on Form P9			
X	15	Form P2 in duplicate			

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Dated this 3rd day of July 2001.

McCALLUM, RADEMEYER & FREIMOND
PATENT AGENTS FOR APPLICANT(S)

REGISTRAR OF THE COURT OF THE COMMISSIONER OF PATENTS
3. 1. 2002 Post-dated
2001-07-03
REGISTRAR OF PATENTS
REPUBLIC OF SOUTH AFRICA

FORM P6

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

PROVISIONAL SPECIFICATION

(Section 30(1) - Regulation 27)

Post-dated

OFFICIAL APPLICATION NO			LODGING DATE	
21	01	20015465	22	3.1.2002. ~~3 JULY 2001~~

FULL NAME(S) OF APPLICANT(S)

71	NXCO INTERNATIONAL LIMITED

FULL NAME(S) OF INVENTOR(S)

72	To be advised

TITLE OF INVENTION

54	TIMED SHOCKWAVE CONCENTRATOR

BACKGROUND OF THE INVENTION

This invention is concerned generally with a customized low energy method of breaking rock in a controlled manner.

As used herein the word "rock" includes rock, ore, coal, concrete and any similar hard mass, whether above or underground which is difficult to break or fracture. It is to be understood that "rock" is to be interpreted broadly.

A number of techniques have been developed for the breaking of rock using non-explosive means. These include a carbon dioxide gas pressurisation method (referred to as the Cardox method), the use of gas injectors (the Sunburst technique), hydrofracturing and various methods by which cartridges containing energetic substances pressurise the walls or base of a sealed drill hole to produce penetrating cone fractures (known as PCF).

These techniques may be an order of magnitude more efficient than conventional blasting in that they require approximately 1/10 of the energy to break a given amount of rock compared to conventional blasting using high explosives. The lower energy reduces the resulting quantity of fly rock and air blast and to an extent allows the rockbreaking operation to proceed on a continuous basis as opposed to the batch-type situation, which prevails with conventional blasting.

Most non-explosive rockbreaking techniques rely on the generation of high gas pressures to initiate a tensile fracture at the bottom of a relatively short drill hole.

The aforementioned techniques rely on the generation of high pressure jet material to initiate a tensile fracture at the bottom of a drill hole. The invention is concerned with a technique and apparatus which can be used to enhance or modify the aforementioned process.

SUMMARY OF INVENTION

The invention provides a method of breaking rock which includes the steps of:

(a) loading a cartridge into a hole in a rock face;

(b) at a first predetermined time initiating a propellant, at least at a first zone, in the cartridge thereby to cause the release of pressurised material; and

(c) at a second predetermined time carrying out at least one of:

(i) detonating an explosive in the hole, and

(ii) initiating the propellant at least at a second zone in the hole.

The first and second predetermined times can, in essence, be coincident. However a predetermined interval may exist between the first and second predetermined times.

According to requirement the first predetermined time may be before the second predetermined time, or vice versa.

The explosive in the hole may be separate from the cartridge and may be physically displaced from the cartridge. Alternatively the explosive may be inside the cartridge or on an outer side of the cartridge.

Where a time interval exists between the first and second predetermined times the duration of the time interval may be controlled by using electronic techniques.

The blasting agent and the explosive may be initiated and detonated, respectively, by means of respective control signals which are transmitted from a control unit or units via control lines or by using wireless techniques.

"Propellant" is to be distinguished from an "explosive" or "high-explosive". Each of the latter terms, which are used interchangeably herein, means an energetic substance which gives rise to an explosive shock wave which results from a more rapid detonation or combustion of the energetic substance, than that which occurs with the propellant.

The invention also extends to apparatus for breaking rock which includes a cartridge which forms an enclosure, a propellant inside the enclosure, an explosive, and a control unit which initiates the propellant at a first predetermined time and which detonates the explosive at a second predetermined time.

The first and second predetermined times may be coincident or a predetermined time interval may exist between the first and second predetermined times.

The control unit may be an integral mechanism or may include a first mechanism which is used for initiating the propellant and a second mechanism which is used for detonating the explosive.

The explosive may be separate, ie. physically displaced, from the cartridge, positioned on an outer surface of the cartridge, or located inside the cartridge.

The control unit may be used for generating control signals which are transmitted to the propellant and to the explosive respectively, for initiation and detonation thereof. The control signals may be transmitted using communication links of any appropriate kind eg. physical conductors or optic links, or by making use of wireless techniques or the like.

As used herein "propellant" is to be interpreted broadly to include a propellant, blasting agent, gas-evolving substance or similar means which, once initiated, generates high pressure jet material typically at least partly in gaseous form. This type of propellant is known in the art. "Blasting agent" and "propellant" are used interchangeably in this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is further described by way of examples with reference to the accompanying drawings in which:

Figure 1 is a side view in cross section of apparatus for breaking rock according to the invention,

Figure 2 schematically illustrates a control circuit which is used in the method of the invention, and

Figure 3 illustrates an alternative control circuit for use in the method of the invention.

DESCRIPTION OF PREFERRED EMBODIMENT

Figure 1 of the accompanying drawings illustrates a hole 10 which is drilled into a rock mass 12 from a face 14 using conventional drilling equipment, not shown. The hole is drilled to a length which is at least four times the nominal diameter of the hole.

A cartridge 16 is loaded into the hole. The cartridge has a base 18 and a cylindrical side wall 20 which extends upwardly from the base and which terminates in a rounded upper end 22.

The cartridge 16 forms an enclosure for a propellant material 24 of known composition which is loaded into the cartridge under factory conditions using techniques which are known in the art. An initiator 26 is loaded into the cartridge, preferably on site.

Control wires 28 lead from the initiator to a control unit 30 which is positioned at a safe location.

Stemming 32 is placed into the hole 10 from the rock face 14 covering the cartridge to a desired extent. The stemming is consolidated in position by means of a tamping or similar process. The nature of the stemming and its manner of use are known in the art and for this reason are not further described herein.

The cartridge contains a ring of explosive material, designated 36, which is positioned on an inner surface of the wall 20. A control lead 28A extends from the explosive ring to the control unit 30.

Figure 2 illustrates somewhat schematically the use of the control unit 30 in conjunction with a circuit 40 which is associated with the initiator 26 and a circuit 42 which is associated with the explosive 36.

The control unit 30 is powered by an external source 44, for example a battery, and includes a wave generator 46 which produces coded pulses each of an appropriate shape and with a desired energy content, using techniques which are known in the art and which are impressed on the line 28.

The circuit 40 is preferably mounted inside a housing of the initiator 26 as is somewhat schematically illustrated in Figure 1. Similarly the circuit 42 is physically located adjacent the explosive ring 36, again as is indicated in Figure 1.

The circuit 40 includes a timer 48 and a capacitor 50. The mechanism 42 includes a separate timer 52 and a capacitor 54. An active component of the initiator 22 which, when energised, produces a hot spot which results in initiation of the propellant 24 is designated 56 in Figure 2. A similar hot spot initiator, which is used to detonate the explosive 36, is designated 58 and is connected to the timer 52. Hot spot initiators of this type are known in the art and consequently are not further described herein.

When the rock breaking process is commenced a control signal is sent from the unit 46 on the line 28 to the initiator 26. The control signal is also applied by the line 28A to the capacitor 54. The capacitors 50 and 54 are charged by the control signal to respective voltages which permit operation of the timers 48 and 52. These devices may communicate with each other via the line 28A and their operation can therefore be coordinated or synchronised so that each timer commences, at the same instant, timing a respective predetermined time interval. Through the use of suitable electronic circuitry highly accurate and precisely controlled timing intervals can be achieved.

When the timer 48 reaches the end of its timing interval energy from the charged capacitor 50 is discharged, by closing an internal switch in the timer, into the hot spot initiator 56. Similarly at the end of the timing interval of the timer 52, closure of an internal switch in the timer causes the discharge of energy from the capacitor 54 into the hot spot initiator 58. When the hot spot initiator 56 is energised it causes combustion of the propellant 24. Similarly energisation of the hot spot initiator 58 causes detonation of the explosive 36.

Normally the difference between the time at which the propellant is initiated and the time at which the explosive is detonated is small, of the order of micro-seconds, and although the combustion of the propellant takes place rapidly the resulting shock wave does not cause the cartridge to disintegrate before the timer 52 causes the explosive 36 to be detonated. In other words although the propellant and the explosive are initiated in rapid succession the time interval between these two events can be precisely controlled in order to optimise the effect which the explosive has on the shock wave which is released by the combustion of the propellant.

The control wires 28 and 28A may be conductive, for conveying electrical signals, or may be formed by fibre optic cables for conducting optical signals. In the latter case it is not feasible however to transmit meaningful quantities of energy from the control unit to the circuits 40 and 42. In this instance the capacitors 50 and 54 are dispensed with and are replaced by small onboard batteries which provide the required energy for operating the timers and for energising the respective hot spot initiators.

Figure 3 illustrates a wireless technique which is used in place of a physical connection between the control unit 30 and the cartridge. The control unit 30 includes a timer 60 which is powered from an electrical source 62. A transmitting antenna 64 is used to radiate a signal 66 to a receiving antenna 68 which is positioned at the initiator 26. The received signal is rectified by a diode 70 and the rectified output is used to charge a capacitor 72. An onboard timer 74 is powered by the capacitor 72 and, at an appropriate time

which is measured by the timer, energy from the capacitor 72 is discharged into a hot spot initiator 76.

Clearly suitable safeguards must be built into the control system, which is used for firing the propellant, to ensure that stray signals from extraneous sources, including noise, do not inadvertently cause initiation of the propellant.

Dated this 3rd day of July 2001.

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Patent Agents for the Applicant

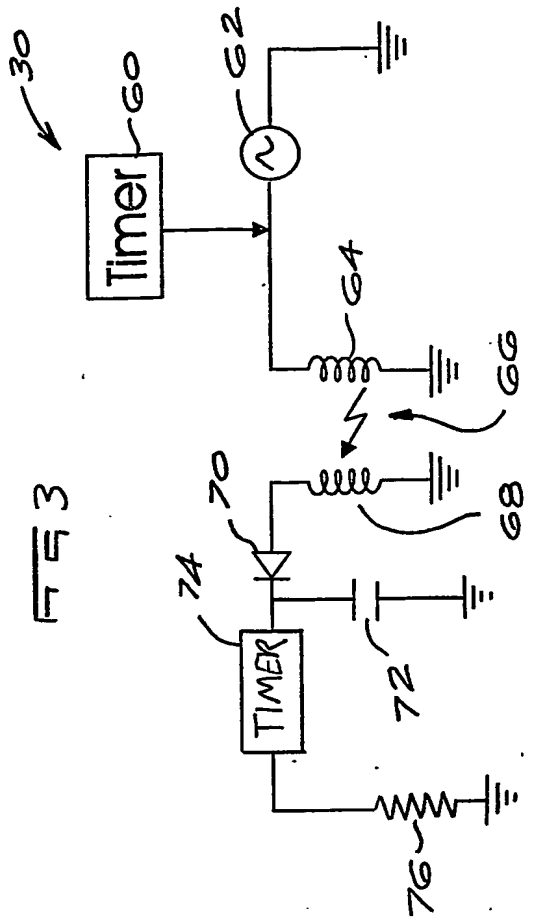

FIG 3

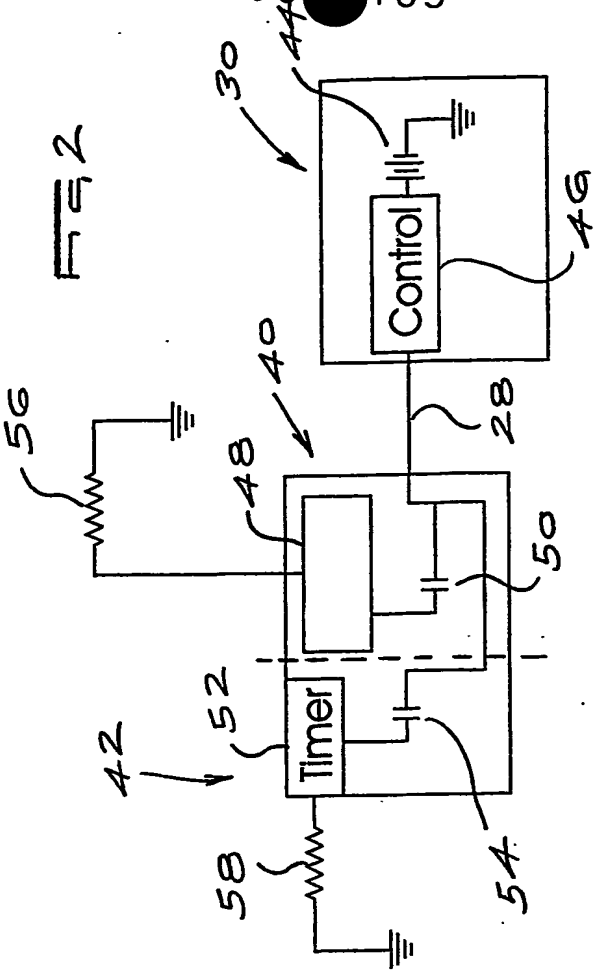

FIG 2

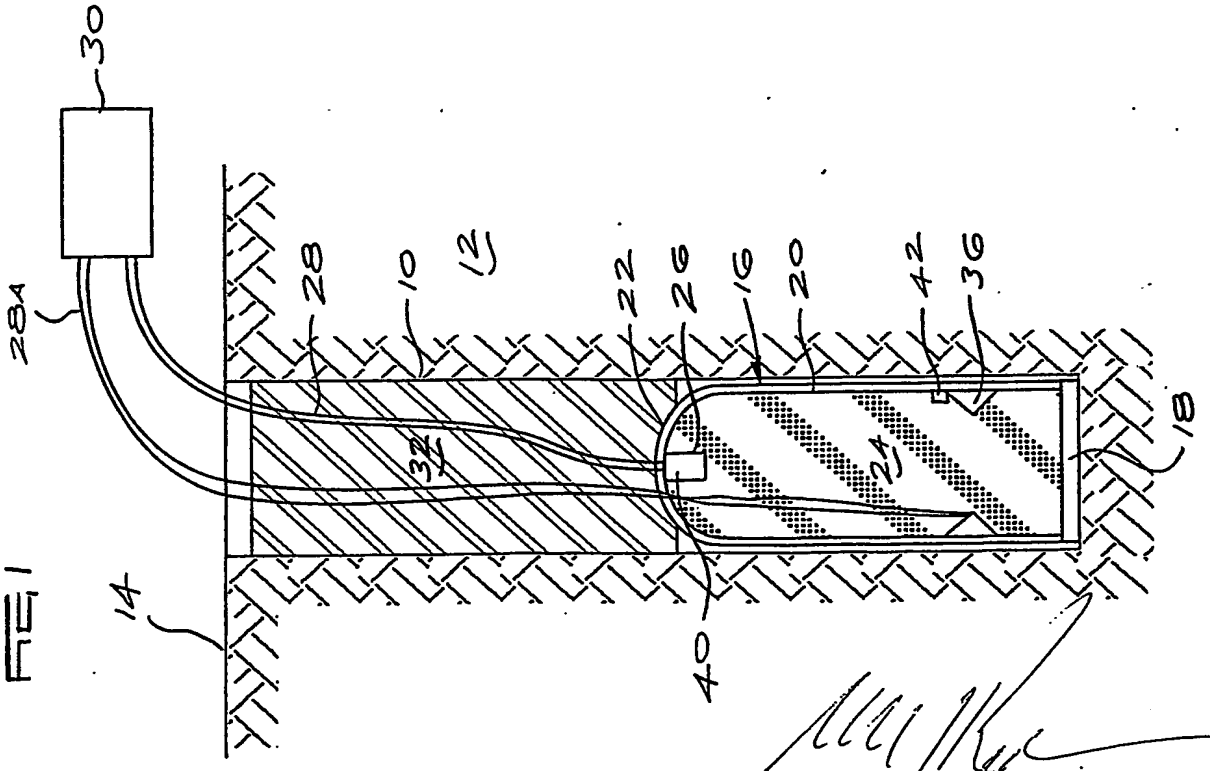

FIG 1

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